



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(71) Applicant: <b>APPLIED MATERIALS, INC. [US/US]; 3050 Bowers Avenue, Santa Clara, CA 95054 (US).</b>			
(72) Inventors: <b>BENCHER, Christopher, 977-2 Asilomar Terrace, Sunnyvale, CA 94086 (US). FENG, Joe; 444 Saratoga Avenue, #17L, Santa Clara, CA 95050 (US). SHEK, Mei-Yee; 33 Stanley Road, Burlingame, CA 94010 (US). NGAI, Chris; 2606 Summit Drive, Burlingame, CA 94010 (US). HUANG, Judy; 16788 Leroy Avenue, Los Gatos, CA 95032 (US).</b>			
(74) Agent: <b>TACKETT, Keith, M.; Thomason, Moser &amp; Patterson, Suite 1500, 3040 Post Oak Boulevard, Houston, TX 77056 (US).</b>			
(54) Title: <b>SILICON CARBIDE FOR USE AS A LOW DIELECTRIC CONSTANT ANTI-REFLECTIVE COATING AND ITS DEPOSITION METHOD</b>			
(57) Abstract			
<p>The present invention generally provides a process for depositing silicon carbide using a silane-based material with certain process parameters that is useful for forming a suitable ARC for IC applications. The same material may also be used as a barrier layer and an etch stop, even in complex damascene structures and with high diffusion conductors such as copper as a conductive material. Under certain process parameters, a fixed thickness of the silicon carbide may be used on a variety of thicknesses of underlying layers. The thickness of the silicon carbide ARC is substantially independent of the thickness of underlying layer for a given reflectivity, in contrast to the typical need for adjustments in the ARC thickness for each underlying layer thickness to obtain a given reflectivity. A preferred process sequence for forming a silicon carbide anti-reflective coating on a substrate, comprises introducing silicon, carbon, and a noble gas into a reaction zone of a process chamber, initiating a plasma in the reaction zone, reacting the silicon and the carbon in the presence of the plasma to form silicon carbide, and depositing a silicon carbide anti-reflective coating on a substrate in the chamber. Another aspect of the invention includes a substrate having a silicon carbide anti-reflective coating, comprising a dielectric layer deposited on the substrate and a silicon carbide anti-reflective coating having a dielectric constant of less than about 7.0 and preferably about 6.0 or less.</p>			

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## INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 99/22317

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H01L21/027 H01L21/314 H01L21/768 H01L23/532 C23C16/32  
C01B31/36

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H01L G03F C23C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 725 440 A (DOW CORNING) 7 August 1996 (1996-08-07)	1,2,10, 18,19, 21,22, 24-28, 32,39, 42,43, 54,65,66
A	column 1, line 3 - line 16 column 1, line 46 - line 58 column 2, line 13 - line 54; figure 1 column 3, line 7 - line 52 column 4, line 40 - line 50	3-9, 11-17, 20,23, 29-31, 33-38, 40,41, 44-49
	-/-	

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

## \* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
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"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search

16 February 2000

Date of mailing of the international search report

- 6. JULI 2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 851 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer:

KLOPFENSTEIN P.

## INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 99/22317

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>---</p> <p>US 4 532 150 A (ENDO MORINOBU ET AL) 30 July 1985 (1985-07-30) cited in the application column 1, line 5 - line 21 column 2, line 1 - line 26 column 2, line 35 -column 3, line 15 column 3, line 42 -column 4, line 33 column 4, line 53 -column 5, line 23; figure 1 column 5, line 46 -column 6, line 48</p>	<p>24-28, 42,43, 46,47</p>
A		<p>1,4,12, 14-16, 18, 21-23, 29,48,49</p>
A	<p>---</p> <p>US 5 741 626 A (JAIN AJAY ET AL) 21 April 1998 (1998-04-21) column 1, line 6 - line 10 column 1, line 42 - line 49 column 2, line 10 - line 46 column 4, line 52 -column 5, line 16; figures 6,7 column 5, line 34 -column 6, line 4; figures 9,10 column 6, line 26 - line 60; figures 13-15 -----</p>	<p>6,12,18, 34,39</p>

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US 99/22317

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
  
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
  
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
  
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-54, 65, 66

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

1. Claims: 1-54, 65, 66

Structures with multiple coatings including an SiC anti-reflective coating (ARC) with a low dielectric constant and a process for forming the SiC layer.

2. Claims: 55-64

Multilayer structures including an SiC anti-reflective coating, characterized by a specific formula expressing a condition relating the absorption and reflection indexes.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 99/22317

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0725440	A	07-08-1996	US 5818071 A	06-10-1998
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